Forests are complex ecosystems and a prominent part of Alberta's landscape. To understand forest health, one must first become familiar with forests and understand the complex systems that drive their **ecological processes**.

A forest is a large area of land primarily covered with trees. Although some tree species look similar, natural forests are rarely made of only one tree type. Some forests can be comprised of mainly broadleaf trees like poplar and birch whose wide, flat surfaced leaves turn colour and are shed in the fall. Other forests consist of conifers like spruce, pine and fir that have needles and produce cones. Quite often however, Alberta's forests contain a combination of both coniferous and broadleaf trees and are called mixed-wood forests.

But there are more to forests than just trees. Countless other living organisms such as smaller plants, animals, microorganisms and non-living components (e.g., soil, water, air) naturally interact and together form a forest ecosystem. As well, variations in geography, geology and climate combine to form distinct forest types. In Alberta, there are four natural forest regions: the boreal, subalpine, montane and aspen parkland. Specific trees, animals, soil and landscape characterize each region.

Did you know? All coniferous trees produce two types of cones: a seed cone and a pollen cone.

How does a forest grow?

Succession is the term used to describe the process by which a forest originates, grows and changes over time. There are different stages in succession. In the first stages grasses, wildflowers, shrubs and small trees are the most common. In Alberta, early successional trees are often trembling aspen or lodgepole pine. As these trees grow they become the more dominant **species** of vegetation, resulting in more shade to the underlying forest floor. Then, other shade-tolerant plants and

Ecological processes – the interactions that occur between organisms (plants and animals) and the environment they live in.

Species – the smallest unit used to classify the lowest natural grouping of similar plants or animals, which form a successfully interbreeding population of organisms that are not able to successfully breed with any other organisms.

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tree species, such as white spruce, will grow underneath, increasing the diversity of the forest. As time passes, certain trees will grow to become very old (over 100 years) while others may die of old age, disease or some disturbance. Sooner or later, a large-scale disturbance such as fire, insect or disease outbreak will remove most vegetation including the older trees, returning the nutrients back to the soil, and the process is able to start all over again.

Why are forests important?

In Alberta, we are fortunate to have abundant and healthy forest resources, which are important for many reasons. Economically, Alberta's forests provide a very significant contribution to the province's wealth. In fact, forestry is Alberta's third largest industry, supplying fibre materials to make paper and lumber products that are sold at home and abroad. Environmentally, forests cycle carbon, produce oxygen, protect watersheds and provide habitat for wildlife. Socially, they provide humans with scenic recreational areas for camping, fishing, hunting, hiking, bird watching and tourism.

How do we know if a forest is healthy?

A healthy forest is able *to sustain itself ecologically while providing for society's economic, social, recreational and spiritual needs and values.* To determine if a forest is healthy, measures must be taken with a particular set of perspectives in mind. A hiker might measure the health of a forest by the green scenery; a birdwatcher might measure the number of bird species present. Overall, the health of the forest may be measured against many variables: the health of trees, the amount and type of wildlife within the forest, and the amount of **biodiversity**.

Biodiversity or biological diversity is the variety of life in a given area.

What is forest health?

Forest health is a term used to describe the condition of a forest and how well it is able to meet management objectives. From a forestry perspective, management objectives focus on the health of the trees. Forest health can also indicate the condition of the overall global environment. For example, acid rain and the greenhouse effect can be detected and monitored in a forest.

Who manages the forest health program in Alberta?

Overseeing the forest health program within Alberta's forests is a mandate of the Land and Forest Division of Alberta Sustainable Resource Development. Forest Health Officers, foresters and technicians work in partnership with the public, forest companies, universities and other provincial and federal government departments to manage certain pests that adversely affect forest health. All of this ensures that Alberta's forests and ultimately Canada's forests are able to meet the specific management objectives set for today and the future. Sustainable Resource Development works closely with other provincial and federal agencies and their counterparts in the United States to collectively provide forest health information on a national and international level.

Factors Affecting Forest Health

Many factors have negative effects on the health of a forest. Some are biotic or living, such as insects, disease-causing organisms or mammals. Others are abiotic or non-living, such as drought and severe weather events like hail and ice storms.

Common factors affecting forest health:

1. **Insects and Mites**
2. **Disease-causing Organisms**
3. **Disorders**
4. **Mammals and Birds**
5. **Exotic Pests and Invasive Plants**

Most of the above factors are a natural part of the forest ecosystem. However, when some organisms threaten the overall health of the trees, or compete with us in the use of the forest, we identify them as **pests**. Typically, pests are organisms that occur in unwanted numbers and places.

Pests: Insects, other animals, disorder, invasive plants and pathogens that can threaten a forest by damaging the trees and environment that people think are valuable.

1. **Insects And Mites** - There are over 10 000 species of insects and mites found in Alberta and many of them use forests in one way or another. Forest insects and mites commonly use trees as a source of food and shelter during certain stages of their life cycles. Usually they are a natural part of the ecosystem, but when the population and activity of a certain species becomes extreme, they can damage the health of a forest by weakening and even killing many trees. Mountain pine beetle, spruce budworm, forest tent caterpillar and large aspen tortrix are examples of forest insect pests in Alberta.

   In a healthy forest, forest insects and mites play important roles. They are sources of food to other insects, spiders, birds and small mammals. They also remove weakened trees to make room for healthy, young plants.

Did you know?
Forest insects and disease accounted for 36% of timber volume loss in Alberta between 1988 and 1992.

2. **Disease-Causing Organisms** can affect living trees by limiting growth, causing abnormal tree growth, weakening trees or even killing them. There are many different kinds of disease-causing organisms in Alberta's forests, such as parasitic plants and microorganisms, including fungi. Examples of forest tree diseases in Alberta include Armillaria root disease, spruce needle rust, western gall rust, and lodgepole pine dwarf mistletoe.

   It is important to note, as with all native organisms in a forest, most diseases are natural and must not be viewed as purely negative. They can be beneficial by removing weakened trees, creating openings in the forests and helping the process of decomposition and nutrient cycling.

3. **Disorders** are non-contagious, non-living elements of the environment that can damage trees. They include adverse weather events such as hail and ice storms, drought, pollution, nutrient deficiencies and mechanical injuries.

4. **Mammals And Birds** use trees for food, shelter and/or hunting grounds, and are a natural part of the forest ecosystem, although cattle and horses are introduced animals to the Alberta's forest ecosystem. Sometimes their actions hinder the growth of trees and increase the possibility of infection from insects and diseases. Cattle, horse, elk, bear, porcupine, snowshoe hares, red squirrels, mice, and yellowbellied sapsuckers are typical examples of mammals and birds that damage trees.

5. **Exotic Pests And Invasive Plants** Exotic pests are organisms that are introduced into an area that is beyond their natural range of occurrence and become pests in the new environment. They are also referred to as alien, non-native, non-indigenous or introduced pests. In the past, introductions have been intentional or unintentional. Having evolved in a different ecosystem, these non-native species may have few natural enemies in their new environment, which can often lead to outbreak populations and can damage native tree species. Asian gypsy moth, Asian longhorned beetle, and European spruce bark beetle are some examples of exotic pests that could threaten Alberta's forests.

   Non-native invasive plant species, often referred to as weeds, can affect the health of the native plant community of the forests they invade. Invasive plants are characteristically adaptable, aggressive and have a high reproductive capacity. Invasive plants are introduced to forested areas on vehicles, on equipment and in seed mix. Also, soil disturbances resulting from many types of activities provide weed seeds with a suitable location to germinate and flourish. These plants have the ability to alter wildlife habitats, displace native threatened or endangered plant species and reduce the grazing capacity of native range land. Purple loosestrife, scentless chamomile and tall buttercup are examples of exotic plants that have invaded Alberta.

What you can do to prevent the spread of exotic pests and invasive plants?

The issue of exotic pests and invasive plants is a tough one to solve and there are a few things we can do to prevent future biological invasions:

➢ Plant only approved trees or plants in your yard and garden. As an example, purple loosestrife is one plant invader to Alberta's wetlands that was introduced and spread through local gardens.

➢ Never release exotic pet species like fish, insects, or reptiles into the wild.

➢ Do not take live plants with you when you travel unless they have been certified pest free.

- Never travel with products that may carry other organisms unless they have passed inspection. (e.g. fruits and vegetables may carry fungi or viruses.)
- After returning from visits to other areas inside or outside of Alberta, inspect your camper, outdoor equipment, toys, furniture, and recreational vehicles for "visitors," including egg masses, pupae or seeds.
- Wash the bottom of your boat, farm or forestry machinery, and scrub the soles of your shoes before you travel to other places, even in Alberta. Seeds and insect eggs hitchhike on the bottom of your shoes and you may unwittingly become a "carrier."
- Carefully examine wooden packaging products, especially ones from other countries, for signs of insects or disease. Do not stockpile packaging material, especially near forested areas.
- Avoid transporting firewood from one area to another, especially if the firewood has the bark still attached. Mountain pine beetle and Dutch elm disease can be transported in firewood to Alberta.
- Report suspicious pest findings to your nearest Alberta Sustainable Resource Development office.
- Learn more about the problem of biological invasions.

Detection and monitoring of forest pests

Pest detection, survey and monitoring, risk and impact assessment and management programs in forest stands help maintain forest health. As part of *the integrated pest management strategy*, Alberta Sustainable Resource Development detects and monitors forest insects and diseases in Alberta. Mountain pine beetle, spruce beetle, aspen defoliators (such as forest tent caterpillar, Bruce spanworm and large aspen tortrix), spruce budworm, and dwarf mistletoe are the major forest pests currently surveyed in Alberta. Alberta Sustainable Resource Development has formed a partnership with the forest companies to assist with surveys. Monitoring for detection of exotic insect and disease pests not yet found in Alberta, such as gypsy moth, is conducted jointly with the Canadian Food Inspection Agency and Natural Resources Canada. Also, Alberta Sustainable Resource Development and forest land users work cooperatively to minimize the spread of invasive plants in Alberta's forested areas.

Did you know? Aerial surveys have been conducted by helicopter in the spring and fall to detect mountain pine beetle infestations along the southwestern border. Infestations have been found within Banff National Park and are moving eastward.

What methods are used to manage a forest health problem?

Pest infestations or outbreaks are evaluated for the potential of spreading to other areas; the extent and severity of damage; the importance of the tree species attacked; and the overall impact the pest will have on the forest. If the pest has the potential to spread and cause severe damage, strategies have to be established based on the land management objectives identified. All economic, environmental, and social factors for a given area also need to be considered. The following identifies the main categories of pest management strategies:

1. **Natural control:** In some cases, allowing nature to run its course can be the best control strategy. Adverse weather and natural enemies such as **pathogens, parasitoids** or **predators** may be able to naturally control some pest populations. This strategy is used where population decline due to natural factors is evident, or where control costs outweigh the benefits, since some control techniques are very expensive. Ultimately, as an outbreak continues, the number of susceptible host trees will eventually decrease, which will in turn reduce the pest population. This strategy may result in some trees being weakened or killed.
2. **Pest-directed actions:** The focus of this strategy is to directly target the pest to reduce the population and prevent the spread of the pest. This can include short-term actions such as destroying infected trees (e.g., using cut and burn for mountain pine beetle control) or the use of biological and/or chemical pesticides (e.g., using a biological agent that is a natural soil bacterium called *Bacillus thuringiensis kurstaki* (B.t.k.) to manage spruce budworm). It can also include long-term actions such as the introduction of a natural enemy. These actions are carefully evaluated for all potential economic, environmental and social impacts.
3. **Forest-directed actions**: This strategy focuses on long term actions to manage host tree species on a large scale or landscape level. Such actions include changing forest stand conditions by prescribed fires or harvesting trees that may be susceptible to the pests (e.g. areas with mountain pine beetle may be burned).

Pathogens are disease-causing organisms, usually fungi, viruses or bacteria.

Parasitoids are organisms that obtain nutrients from and live part of their lifecycle within another organism or host. In all cases, the host will eventually be killed by the parasitoid.

Predators are naturally occurring organisms, which kill and feed on other organisms.

It is a big job!

Maintaining the health of our forests is a big job in Alberta, involving many agencies including municipal, provincial and federal departments, private industries and the public. In order to maintain all the economic, environmental, and social values we place on this resource, forest managers must take an integrated approach to forest use. They must look beyond individual needs and local stands and measure all of the impacts placed on the forest landscape. By ensuring that forests remain healthy and satisfy a diversity of values, Albertans can enjoy our forests, both at present and in the future.

For more information go to the Alberta Sustainable Resource Development - Forest Health Web site at http://www3.gov.ab.ca/srd/forests/health/

For questions about forest health contact fh.info@gov.ab.ca

For an online version of this document, go to http://www3.gov.ab.ca/env/resedu/factsheets.cfm

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Pub No. T/616

Phone: (780) 944-0313 (Toll free in Alberta by calling 310-0000)
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E-mail: env.infocent@gov.ab.ca
ISBN: 0-7785-1741-1 (Printed Edition)
0-7785-1742-X (On-line Edition)